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IMPORTANT ASPECTS OF SOME UNDERUTILIZED FRUITS CROPS AND THEIR WILD RELATIVES FOR FOOD AND NUTRITIONAL SECURITY IN DARJEELING HIMALAYAS

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ABSTRACT

The present study was carried out in Darjeeling, India during 2013 to 2014. Field survey was conducted for collecting information regarding utilization aspects of some underutilise fruits. Important wild fruits were selected on the basis of their easy availability and on their food, medicinal and other values in Darjeeling regions. Morphological descriptions were given after consulting with botany experts and information gathered from various literatures. The most common and popular value added product was fat/butter extracted from the fruits of *Machilus edulis* and *Diploknema butyraceae*. Similarly, wild fruits were also processed into pickles, jam, curry, juices, confectionaries, vinegar and wine or alcohol by local people. All these fruits were good source of fat, protein, sugars and antioxidants. Most of the species were found to have many therapeutic uses. The most frequently utilized plant parts are bark, followed by roots, fruits, seeds. Majority of the plant parts were prepared in the form of juice followed by paste and powder. Moreover many species were also exploited for various non fruit utilities like charcoal purpose, fuel wood, construction and fence. Indigenous minor or wild fruits had thus crucial contribution towards subsistence economy and livelihood of Darjeeling. Further, such documentation will benefit the community through the use of locally and freely available health giving foods which will also help preserve their cultural pride.

KEYWORDS: Wild Fruits, Morphological, Utilization, Quality

INTRODUCTION

Rural areas are the habitat of the world's three quarter poorest people who are dependent for their livelihoods in one way or another on agriculture and access to natural resources (Anon, 2001). Agricultural and Natural Resources (ANR) of developing countries not only provide vital food supplies, employment, health care and raw materials for billions of their own population but valuable raw materials, cash crops and timber for the developed world population as well. Due to its diverse climate, India possesses more than 600 species of fruit plants. The Darjeeling Himalayas, a part of Indo-Malayan Biodiversity Hotspot (Myers and Mittermeier, 2000) harbours many fruit plants grown in wild habitats and indigenously utilized.

Most of these are minor, cheap and readily available with vibrant taste appeal. Their potential in nutritional, medicinal, therapeutic and industrial values is well recognized and utilized by the indigenous communities (Rai *et al*., 2005). Many value added products can be obtained from these indigenous minor fruits also. Many of the minor fruit and other edible plant species are threatened and in the verge of extinction due to over extraction, deforestation, and pollution (Rai *et al*., 2000). The deterioration of environmental factors and extinction of biodiversity thus warrants sustainable

conservation and documentation of indigenous knowledge base. Efforts are required to preserve and document the indigenous knowledge base of local and indigenous communities and its subsequent sustainable utilization. Today almost all modern human food is based on a limited number of crops. Since food and phyto-resources are shrinking globally with the hike in population, it is need of the hour to find new alternatives. Thus these minor indigenous or wild edible fruit species can aid in crop improvement, ecological and food security. Although these species continue to be maintained by cultural preferences and traditional practices but they still remain inadequately characterized and neglected by research and conservation. Lack of attention indicates that their potential value is under-estimated and under-exploited. It also places them in danger of continued genetic erosion and disappearance. This would further restrict development options for poor. Therefore, exploration of these plants with their ethno-biological values is important for knowing and evaluating their economic potential.

Research on the utilization aspect will help to identify new uses, improve production of already known products and also promote welfare of the local community. Unfortunately, little research has been done on identification and utilization. The information available on minor indigenous fruit or wild fruit species is also scanty. Fortunately scattered reports do indicate initiation of works on documentation, crop improvement, agro-technique standardization and value addition of these fruit crops are available but it still needs thorough botanical and utilization studies and documentation.

Research concerning the socio-economic, cultural, traditional, nutritional and conservation aspects of minor-food plants still lacks adequate attention especially information on these fruit species is extremely scarce in general and particularly in Darjeeling Himalayas. Darjeeling and the surrounding region have a great potential in the development of herbal enterprise that can be linked with conservation and economic development (Sundriyal and Sundriyal, 2001a & b, 2003). Efforts need to be directed towards better maintenance of their resource base, both through ex situ and in situ conservation methods, to ensure their development and sustainable use by present and future generations. Considering the pivotal role of wild and underutilized fruit species in ecological and nutritional security along with sustainable livelihood development of local communities in Darjeeling, the present studies were carried out.

MATERIAL AND METHODS

The present study was carried out in Darjeeling, India during November 2012 to March 2013. Darjeeling is a small mountainous northernmost district of West Bengal in the Eastern Himalayan region. Its area is extending over a 3254.7 sq. Km which is bordered by Sikkim in the north, terai and Dooars in the south, Bhutan in the east and Nepal in the west. The climatic condition of Darjeeling hills is temperate to sub tropical in nature and lies between 26^0 31' and $27^0$31' latitude and between $87^0$59' and $88^0$53' longitude. The average rainfall varies appreciably from 2500 to 34000 mm, of which 80 percent is received during June to September. Rainfall is not certain from November to March. In the hills above 200m, the intensity of sunlight is low particularly in the monsoon and winter months. The average maximum and minimum temperature around the year is recorded as 20^0C to 22^0C respectively. The relative humidity varies from 70 to 80 percent depending on the locality and season of the year (Srivastava and Singh, 2002). At highest altitude, humidity is more often causing accumulation of fog and reducing the impact of light intensity (Gangopadhyay, 1991b). The soils of Darjeeling hills are mainly gneiss, schist, phyllite, quartzite, greywake and dolomite. These soils are generally of high fertility status, however high aluminum toxicity has been observed due to the presence of chloritized 2:1 lattice minerals in these soils. The soils are mostly light textured and contain high organic matter. Dominant minerals are mostly mica and chlorite with

mixed layer clays. The soil contain high amount of undecomposed organic matter having high C: N ratio (Gaugopadhyay, 1991b). The sand content is high with low silt and clay content with sandy loam to loam textured. The soils have limited holding power for cationic nutrients and deficient in Ca and Mg. The soil varied from 6.4 to 30.9 g Kg^{-1} organic carbon (Srivastava and Singh, 2002).

Altogether 10 fruit species were selected on the basis of their easy availability and on their food, medicinal and other values in Darjeeling regions. Morphological descriptions were given after consulting with botany experts and compared with the various available literatures. Baseline information needed was taken were collected through surveys and field visits and views of native knowledgeable people on use of wild fruits in local system. Fruit plants were randomly selected from different locations of Darjeeling for visual observations and for their botanical categorizations as well as for their physico-chemical studies. The average value of fruits and their quality attributes was taken as the observation. Total soluble solids (TSS) TSS of fruit were recorded with a hand refractometer calibrated in 0brix at 20 °C with the help of a temperature correction correlation chart (Mazumdar and Majumdar, 2003). Total titrable acidity was determined by titration of a known weight of sample with NaOH using phenolphthalein as an indicator (Ruck, 1969) and expressed in per cent. Total sugar of fruits were estimated following the methods suggested by Ranganna (1979) while non-reducing sugar was estimated as reported by Mazumdar and Majumdar, (2003) and was expressed in per cent. Ascorbic acid was estimated by volumetric method and expressed as mg per 100g of fruit pulp as described by Mukherjee and Choudhuri (1983). Protein was estimated and expressed in per cent following Lowry et al. (1951). Chlorophyll and Carotenoid were extracted following the protocol formulated by Lichtenthaler and Wellburn (1987) and expressed as mg/100 g whereas anthocyanin concentrations was estimated as per method recommended by Cordenunshi *et al.* (2003) and total anthocyanin content was expressed as Cyanidin -3-glucoside on a fresh weight basis as mg $100g^{-1}$. Fat was estimated and expressed in per cent following Thimmaiah (2009).

RESULTS AND DISCUSSIONS

Morphological Aspects of Underutilized Fruits

Ten underutilized or wild edible fruits selected from the study area on the basis of availability and wide usage showed wide variation in their visual attributes. Most of the fruit species were belongs to family rosaceae and having 8 wild in growth features while 3 of them were in semi-domesticated. Inflorescence colour was recorded visually and four species had white flowers while remaining six had varied flower colour. Inflorescence position was recorded visually as terminal, axilliary and both while type was recorded as hermaphrodite, dioecious and monoecious. Among these 10 species, four had axillary, four had terminal and two had both characters while most of the inflorescence type was hermaphrodite. The general morphology and growth, phenology of each of these 10 selected fruit species observed in the study area was in accordance with earlier reports (Bennet *et al.*, 1991; Pakkad, 1997; Sundriyal and Sundriyal, 2004b; Rai *et al.*, 2005) and given species wise in table 1 & 2. Three species were observed to have green to yellow fruits, one were green and remaining five were dark pink, light yellow brown, rusty brown to green, red, green to red and orange yellow colour. Shapes of different indigenous fruits were characterized as oval/oblong, pear shaped/pyriform, spherical/round and others. Fruits of five species were oval, two were spherical and remaining species were oblong and ovoid. Average weight of fruits varied among the different species and maximum fruit weight was recorded for *Machilus edulis* (26.0 g) while the lowest of 1.25 g was recorded for *Castanopsis hystrix*. Mean value of fruit size also indicated *Machilus edulis* and *Eriobolus indica* were recorded as largest fruits while *Castanopsis hystrix* and *Rubus ellipticus* were smallest. Maximum

numbers of seeds were in *Duchesnia indica and Rubus ellipticus* while *Castanopsis hystrix* was single nut fruit. Similar physical parameter studies of indigenous minor or wild edible fruits were also reported earlier (Bagra *et al*., 2006; Karlidag *et al*., 2009).

Table 1: Botanical Aspects of Some Underutilized Fruit of Darjeeling

English Name	Local Name (Nepali)	Botanical Name	Family	Growth Features
Hog Plum	Lupsi	*Spondias axillaris* Roxb. (Burtt & Hill)	Anacardiaceae	Semi-domesticated large deciduous tree
Chebulic Myrobalan	Harra	*Terminalia chebula* Retz	Combretaceae	Wild large deciduous tree
Oleaster	Musleri	*Elaegnus latifolia* L. (Roxb.)	Elaeagnaceae	Semi-domesticated deciduous liana
Chestnut	Kattus	*Castanopsis hystrix* Miq.	Fagaceae	Wild evergreen large tree
Wild Avocado	Pumsi	*Machilus edulis* King	Lauraceae	Semi-domesticated large evergreen tree
Indian Strawberry	Bhui Kapaal	*Duchesnia indica* (Andr.) Focke	Rosaceae	Wild evergreen herb
Indian Crab Apple	Mehel	*Eriobolus indica* Schn. (Wall.) Decaisne	Rosaceae	Wild medium deciduous tree
Himalayan Bird Cherry	Painyuu	*Prunus cerasoides* D. Don	Rosaceae	Wild medium to large deciduous tree
Yellow Himalayan Raspberry	Aiseylu	*Rubus ellipticus* Smith.	Rosaceae	Wild evergreen shrub
Indian Butter Tree	Chuirii	*Diploknema butyraceae* Roxb. Lam.	Sapotaceae	Wild medium to large deciduous tree

Nutritional and Quality Aspects of Underutilized Fruits

Castanopsis hystrix had lowest acidity (0.5 %) while *Terminalia chebula* with 3.85 % acidity was highest. Maximum TSS was recorded in fruits of *Diploknema butyraceae* (18^{o} Brix) and minimum total soluble solid (3^{o} Brix) was recorded in *Machilus edulis*. Highest total sugar was recorded in fruits of *Eriobolus indica* (13.04 %) while *Machilus edulis, Spondias axillaris, Terminalia chebula, Castanopsis hystrix* and *Elaegnus latifolia* had least total sugar (3 %). Non-reducing sugar in fresh fruits of the species varied from 0.1 to 6.0 %. *Diploknema butyraceae* possessed maximum amount of non-reducing sugar while minimum in *Eriolobus indica* and *Castanopsis hystrix*. Highest amount of fat was estimated in *Machilus edulis* (21 %) and lowest in *Eriobolus indica* (0.4 %). Protein content of the fruits ranged from 2 to 10 %. Maximum protein content was estimated in *Prunus cerasoides* while minimum was estimated for *Duchesnia indica, Terminalia chebula and Eriolobus indica*. Maximum ascorbic acid was estimated in *Spondias axillaris* (32.0 mg/100g fresh weight) and minimum 1 mg/100g of fresh fruit was estimated for *Castanopsis hystrix*. Carotenoid of the fruits ranged from 0.2 to 63.0 mg/100g fresh weight. *Machilus edulis* was estimated with highest carotenoid while *Rubus ellipticus* with least. Anthocyanin ranged from 0.1 to 3.8 mg /100g fresh weight. Highest concentration of anthocyanin was estimated in fruits of *Rubus ellipticus* while least for *Castanopsis hystrix* and *Duchesnia indica*. *Machilus edulis* with 2.3 mg/100g fresh weight was estimated with highest chlorophyll while least of 0.06 mg/100g fresh weight was estimated for *Castanopsis hystrix*.

Table 2: Morphological Aspects of Some Underutilized Fruit of Darjeeling

Name English	Inflorescence Colour	Inflorescence Type	Inflorescence Position	Fruit Colour	Fruit Shape	Fruit Weight (G)	Seed Number
S. axillaris	Dull maroon	Dioecious	Terminal	Green to yellow	Oblong	12.00	1
T. chebula	Dull white	Hermaphrodite	Both	Green	Oval	4.86	1
E. latifolia	White	Hermaphrodite	Both	Dark pink	Oblong	9.47	1
C. hystrix	Light to dull yellow green	Monoecious	Terminal	Light yellow brown	Ovoid	1.25	One nut
M. edulis	Greenish yellow	Monoecious	Axillary	Rusty brown to Green	Oval	26 .0	1
D. indica	Bright yellow	Hermaphrodite	Terminal	Red	Spherical to oval	3.02	Many
E. indica	White	Hermaphrodite	Axillary	Green to yellow	Oval or pear shaped	22.3	15
P. cerasoides	Pinkish white	Hermaphrodite	Axillary	Green to red	Oval	2.94	1
R. ellipticus	White	Hermaphrodite	Terminal	Orange yellow	Spherical	2.46	Many
D. butyraceae	White	Hermaphrodite	Axillary	Green to yellow when ripe	Oval	11.24	3

Table 3: Fruit Quality Attributes of Some Underutilized Fruit of Darjeeling

Botanical Name	A	TSS	TS %	NRS %	F	P	AA	C	Ac	Cp
S. axillaris	3.57	6.86	3.16	1.11	1.4	5.4	32.0	0.30	0.60	0.92
T. chebula	3.85	3.98	3.20	0.19	1.5	2.2	7.30	22.4	0.70	2.14
E. latifolia	3.18	6.92	3.03	4.99	0.8	6.2	11.2	5.80	1.81	0.05
C. hystrix	0.47	4.03	3.33	0.14	3.4	3.5	0.70	14.4	0.06	0.90
M. edulis	3.34	3.55	3.03	0.68	21.5	5.6	5.00	62.9	0.40	2.29
D. indica	1.46	6.53	7.52	3.76	1.1	1.8	2.54	19.4	0.07	0.44
E. indica	1.81	11.53	13.04	0.12	0.4	2.1	7.50	0.30	0.50	0.02
P. cerasoides	1.16	7.88	7.30	1.33	9.7	10.0	4.50	0.96	3.00	0.16
R. ellipticus	2.15	6.14	8.73	2.90	5.9	7.6	5.90	0.20	3.80	0.15
D. butyraceae	1.13	18.50	12.21	5.91	1.1	3.9	24.3	7.60	0.60	0.10

UTILIZATION ASPECTS OF UNDERUTILIZED FRUITS

Traditional Uses

People in different areas use their local resources independently (Groombridge, 1994). Indigenous fruit trees are important traditional sources of nuts, fruits, spices, leafy vegetables, edible oil and beverages (Okafor, 1985). In Darjeeling, every indigenous minor or wild edible fruit species is valuable in several other ways pertaining to social, economic and ecological services except in a few species, food value has rather a subordinate role. It was observed that the usage of plants were same for all the areas studied at Darjeeling. Most of the identified indigenous minor or wild edible fruits reported here have multiple local uses as was also reported by several authors (Sundriyal, 1999; Sundriyal and Rai, 1996; Sundriyal *et al*., 1998, 2003; Sundriyal and Sundriyal, 1998, 2001 a & b, 2003, 2005; Rai *et al*., 2005). Some fruit species are commercially important and also has the medicinal value such as *Diploknema butyraceae* and *Terminalia chebula*. Species such as *Rubus ellipticus* and *Elaegnus latifolia* were found delicious fruits for those who can't afford expensive fruit from the market. Likewise, *Spondias axillaris* and many others have found use for spices and pickle purpose along with medicinal and other uses. These species are free and easy to access for the local communities. Some of these food plants are supplementary and nutritionally important especially prior to the harvest of staple foods to the local people as in Nepal (Shrestha *et al*., 2005). These plants are eaten in different ways depending upon the conditions of

locality and community (Singh, 1960; Manandhar, 1974). Some of these fruits were home processed as boiling, roasting and fermentation. Most of these fruits were eaten fresh and raw as snacks or sometimes as potion. Fruits of some species like *Castanopsis hystrix* fruits were consumed dried after roasting and even processed into flour for baking purpose. Rai *et al*. (2005) also reported about fruit processing of *Castanopsis hystrix, Spondias axillaris, Duchesnia indica and Elaegnus latifolia*. Both wild and cultivated fruits were available year round and have a great potential to contribute towards food and nutritional security during food scarcity as was also earlier reported (Adekunle and Oyerinde, 2004; Jeeva, 2009). Indeed, some wild fruit species were found to be well laden with important nutrients. Although, the current level of consumption is very low and the fruits had insignificant role in the diets of the natives. By and large, except for a few species, food value appears to have a subordinate role on the part of indigenous minor or wild edible fruit bearing species. Because of slight variations among sites, varietal differences and the level of management, there appeared a constant supply of fruit produce of one kind or another throughout the year. Fruiting of many species like *Elaegnus latifolia* and *Duchesnia indica* occurs during March in dry season to middle of rainy season which coincides with time staple food scarcity. On the whole, the year-round availability of fruits could help to diversify sources and types of micronutrients in the daily diet of indigenous residents of Darjeeling. Nevertheless, a great portion of the produce was sold than consumed and thus there is a danger that the dietary role of fruits for growers/collectors may be lost that would also impact health. However, the rarity and insignificant role of fruits in people's diets is not peculiar to the study areas rather it is a universal phenomenon (Westphal 1975; Anon., 1999b). Of course, this is contradictory to reports on role of home garden products in several part of the World (Bennett-Lartey *et al*., 2002; Wezel and Bender, 2003; Ali, 2005). The low consumption of fruits is partly attributed to ignorance of their nutritional value and method of preparation, need for cash and more importantly dietary custom of people. Experience shows that counselling to change eating behaviour is an important component food-based strategy (Talukder *et al*., 2001). It was also found out that people in the study areas do not explicitly recognize nutritional contribution of the wild fruits rather they value them as snack. However, empirical analysis of the nutrient composition of some of the marketable species brought to light that they are in fact loaded with important nutrients. This is suggestive of the need for nutritional education and social marketing to achieve sustainable behavioural changes of the community towards these fruit consumption.

Moreover, many fruit species were also exploited for various non-fruit utilities and many considered as good fodder for cattle. Species like *Castanopsis hystrix* were sought for timber purpose though it was mostly found in forest and only a few trees were found growing in homestead gardens. Almost all the indigenous minor or wild edible fruit tree species are utilized for charcoal purpose. Fuel wood, construction and fence are the other major non-food use categories, while *Machilus edulis* and *Castanopsis hystrix* were multiple used species. The harvesting of these multiple use species can put them under threat (Dhillion and Shrestha, 2005) but can also lead to better chances for their conservation (Etkin, 2002). Over utilization of these fruit trees may have detrimental effects on landslide in hilly region. While the multiple uses demonstrate the continuing importance of these resources, the high pressure could also pose them a threat. The study also revealed that some wild fruits like *Spondias axillaris, Machilus edulis, Elaegnus latifolia, Diploknema butyraceae and Terminalia chebula* were actively used fruit species, but were quite limited in number which was brought to the local markets in different quantities for sale to generate additional income. Previous reports from adjoining state of Darjeeling like Sikkim also indicated this (Sundriyal and Sundriyal, 2004d; Chettri *et al*., 2005b; Rai *et al*., 2005).

Value Addition

Processing fruits could enhance their utilization by reducing wastage and improve their marketing prospects thereby further increasing their contribution to household food security and nutrition (Fentahun and Hager, 2009). In turn, this would lead to better value recognition of these fruit species and thus promote their conservation. Also, household processing of these fruits as drying and canning could increase their market value and ensures a year-round supply (Marsh, 1998).

Whole chestnuts (*Castanopsis hystrix*) were roasted, nuts extracted and grinded in a traditional wooden ladle. The powder was sieved and stored in an air tight container (Bhutia, 2012). Fruit species like *Rubus ellipticus* and *Diploknema butyraceae* were added as flavouring agents with other wine making fruits like peach, pear and plum along with few slices of potato and sugar in the ratio half kg sugar: 1 kg fruits (photo 37) and the mix are stored in an air tight container for fermentation (during summer for 20-25 days and winter 45-60 days). After fermentation, the product was squeezed in a muslin cloth. Water can be added according to taste. Fruits were processed into refreshing juice either by boiling or adding lukewarm or cold water to which sometimes sugar or honey is added. Fruits were fermented or were added to flavour other drinks. The most common and popular value added product was the far/butter extracted from the fruits of *Machilus edulis* and *Diploknema butyraceae*. Rai *et al*. (2005) also reported that raw fruits of *Spondias axillaris*, *Duchesnia indica* and *Elaegnus latifolia* are processed as pickle. Similarly, wild fruits were also processed into pickle, jam, curry, juices, confectionaries, vinegar and wine or alcohol by local peoples in other areas (Edwards, 1992; Williams, 1997; Maden, 1998; Leaky, 1999; Zemede and Mesfin, 2001; MacLachlan, 2002; Demel and Abeje, 2004; Pauline and Linus, 2004; Angami et al., 2006; Bagra *et al*., 2006; Kebu and Fassil, 2006; Tabuti, 2007; Fentahun and Hager, 2009; Teklehaymanot and Giday, 2010). Dried fruit from *Terminalia chebula*, flour of *Castanopsis hystrix* and pies, puddings and puree using *Elaegnus latifolian* are very famous items of Darjeeling.

This is suggestive that promotion of fruit production and home gardening in general might have a substantial role in mitigating food insecurity and relieving the locals from clutches of poverty. This in turn would lead to better recognition of the value of fruit species

Table 4: Utilization Aspects of Some Underutilized Fruit of Darjeeling

Botanical Name	Indigenous Uses	Value Added Products	Ethno Medicinal Uses
S. axillaris	Fruits are edible, finer bark chewing is substitute for betel nut	Candies, pickle, chutney	bark against diarrhoea, nausea and vomiting
T. chebula	Fruits edible. The paste of its fruits is applied on the eyelids in conjunctivitis	Dried with honey or jaggery	Bone fractures, Piles, Dysentery, Gastritis, Diabetes, Kidney stones
E. latifolia	Fruits edible and consumed raw and use for making refreshing drink	Pickles, jam, wine, chutney, pies, puddings and puree	Fruits are used against dysentery and vomiting
C. hystrix	Fruits are edible, fuel wood, leaves are good ingredients for composts. It is highly valued for furniture, agricultural implements etc	Flour	Nut oil uses as messaging item to relief from body pain
M. edulis	Fruits edible, leaves are good fodder, fruit extracted Butter/ ghee used as additive in vegetable ghee.	Fat/butter	Leaves are uses for the treatment of fever
D. indica	Fruit are uses for the preparation of local alcoholic	jam and juice	Poultices of fresh

	beverages.		leaves are effective against snake bites and insect bites
E. indica		Pickle	Piles, Dysentery
P. cerasoides	Fruits edible, fairly good fodder and fuel wood	Flavouring item	Burns, Bone fractures
R. ellipticus	Fruits edible	Jams, jellies, pies, and other desserts.	Burns, Piles, Dysentery
D. butyraceae	Fruits are edible. Also used as live fence and fodder. The seeds are used to make a special type of butter for burning lamps and culinary purpose as well.	Fat/butter	Butter extracted from the fruits is used in treating rheumatism.

And thus promote their conservation. Owing to the current trend of decreasing agro-biodiversity (Hadgu *et al*., 2009), there is danger that these fruit species will be lost. Hence there is an urgent need to incorporate research into wild fruits and to promote their use as a part of a strategy to improve food security, nutrition and livelihoods (Fentahun and Hager, 2009).

Ethno Medicinal Uses

The use of plants as a means to cure certain ailments and disease is an age-old practice throughout the world and Darjeeling is not an exception. These fruits have also been used as a medicine while curing many diseases through local health system. The folk medicinal practices are quite common among the ethno-cultural groups of Darjeeling and surrounding areas (Biswas, 1956). Out of 10 selected indigenous minor fruit most of them have medicinal properties to cure the different ailments and diseases (table 4). Most of the species were found to have many therapeutic uses. Survey has revealed that specific plant parts are used to treat different diseases and ailments. The most frequently utilized plant parts are bark, followed by roots, fruits and seeds. Additionally, some have medicinal value in their flowers, rhizomes, tubers and heart wood. In some cases, the whole plant including the roots was utilized. It is important to note that the removal of bark and roots can have significant detrimental effects on plant survival and regeneration (Dhillion and Amundsen, 2000). Paste mixture of stems of *Prunus cerasoides* and *Rubus ellipticus* and root bark of these plant species is applied on the burn and left till it loosens (Bhutia, 2012). Bark of *Eriobolus indica* and root of *Rubus ellipticus* are grounded and one teaspoon of the mixture is taken twice a day with hot glass of water for the treatment of piles and dysentery (Bhutia, 2012). Fruits powder of *Terminalia chebula* at10 g powder is recommended twice a day for diabetes patient while three dry fruits *T. chebula* are dipped in a glass of water for 4 hours and then given to the kidney stone's patient to drink (Bhutia, 2012).

The plant products are consumed raw or in the form of a decoction, juice (mix with water or milk), capsule, curry/spices or an infusion for oral treatment and as burnt product, ointments or raw paste when applied externally. Majority of the plants parts were prepared in the form of juice followed by paste and powder. This is in agreement with earlier report (Dhillion and Shrestha, 2003). For current use, administration of formulation was direct in form of paste or ointment. Mode of preparation is based upon nature of the ailments. There is no set and precise formula for determining the quantity of application used. Knowledge and practices were not directly related to any organized system but has come entirely through oral tradition and personal experience (Bhattarai, 1998). Majority of the species were used against stomach-ache problems (diarrhea, dysentery, cholera and gastric), rheumatic and arthritis. Traditional system of medicine notably Ayurvedic and Tibetan practices from wild plants including fruit plants are extensively used in day-to-day life by

the people in Himalaya (Rai and Sharma, 1994). A number of researchers had documented the use of medicinal plants was based on tradition (Sundriyal and Sharma, 1995; Chanda *et al*., 2002; Maity *et al*., 2004; Angami *et al*., 2006; Hussain and Hore, 2007; Pradhan and Badola, 2008; Bharati and Sharma, 2010; Hebbar *et al*., 2010; Deshmukh and Waghmode, 2011; Namrata *et al*., 2011). Traditional health care system is also an age old practice in India and elsewhere and most of the wild edible fruit plants are used (Jeeva, 2009; Marwat *et al*., 2009 a & b). Earlier studies also reported that about 90 % of rural population in hilly terrain depends on traditional health care system (Kingston *et al*., 2006; Jeeva, 2009). Mostly, traditional use of indigenous minor or edible wild fruit species for medicinal purposes was by herbal healers as well as faith healers rather than consumption for nutritive purposes. It was evident from the study that these indigenous fruit trees are important sources of medicine to the households.

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